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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

SILVER LAKE

WORTH COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 505

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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REPORT

ON

SILVER LAKE

WORTH COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 505

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

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F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

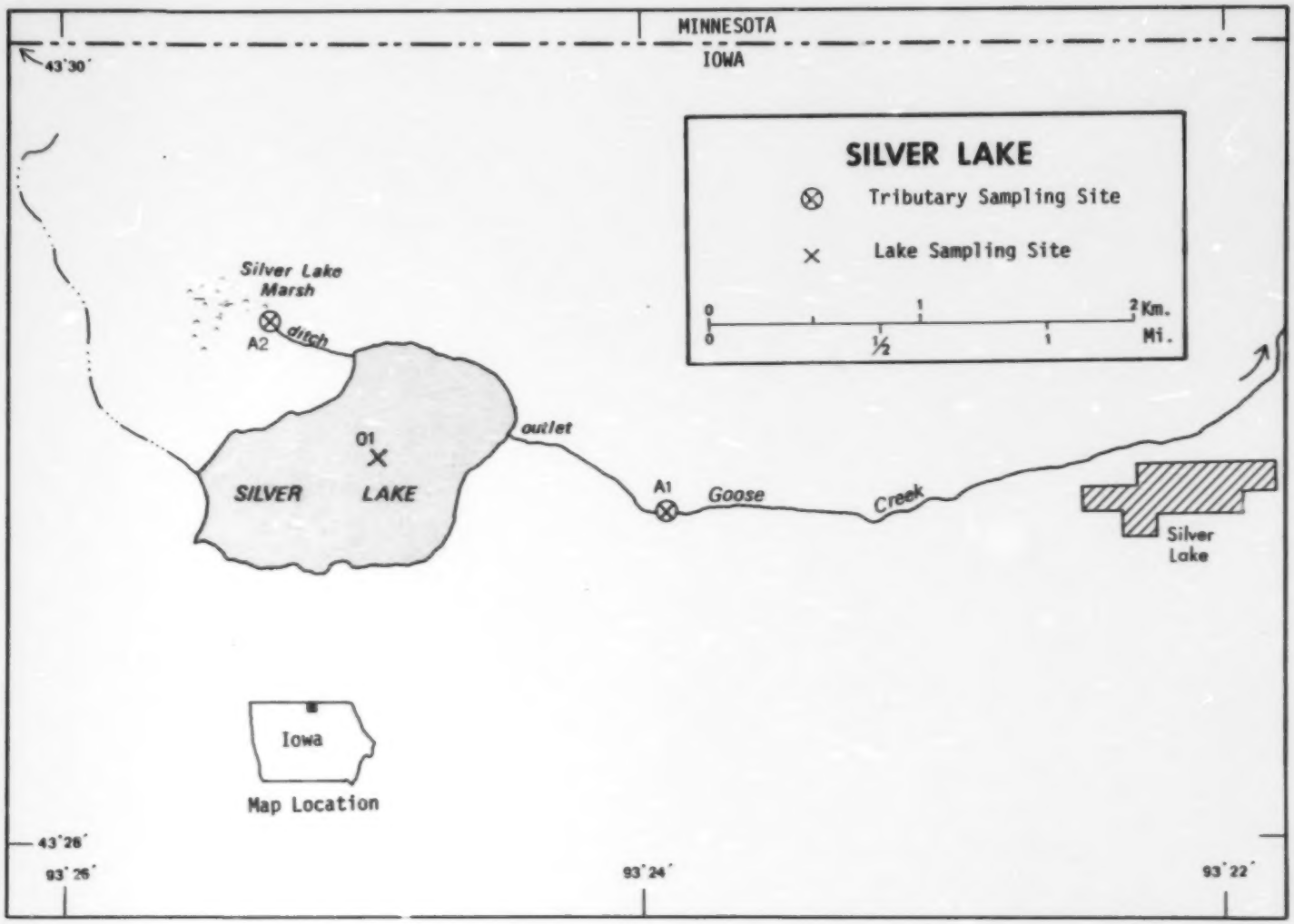
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


MINNESOTA
IOWA
43°30'
SILVER LAKE
Tributary Sampling Site
Lake Sampling Site
0 1 2 Km.
0 ½ 1 Mi.
Silver Lake Marsh
A2
ditch
outlet
01
SILVER LAKE
A1
Goose Creek
Silver Lake
Iowa
Map Location
43°28'
93°26'
93°24'
93°22'

SILVER LAKE

STORET NO. 1912

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Silver Lake is eutrophic. It ranked last in overall trophic quality when the fifteen Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six lake parameters*. All of the other water bodies had less median total phosphorus and mean chlorophyll a, 13 had less median orthophosphorus, eight had less median inorganic nitrogen, and 13 had greater mean Secchi disc transparency.

Survey limnologists did not observe surface algal concentrations during sampling visits. However, the numbers of phytoplankton in July and September indicate that blooms were in progress at those times (see page 6).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Silver Lake was limited by phosphorus at the time the assay sample was collected (04/18/74). The lake data indicate phosphorus limitation in April and nitrogen limitation in September.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Silver Lake during the sampling year.

* See Appendix A.

It is calculated that the lake received a total phosphorus loading of 0.24 $g/m^2/yr$ which exceeds that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11).

Survey limnologists noted that Silver Lake is surrounded by farms, and it is possible that the estimate of the phosphorus load from the minor tributary and immediate drainage area of the lake is too low.

2. Non-point sources--All of the phosphorus entering the lake during the sampling year came from non-point sources. Tributary A-2 contributed about 32% of the total phosphorus load, and the minor tributaries and immediate drainage were estimated to have added about 60% of the total phosphorus load.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 1.29 kilometers^2.
2. Mean depth: 1.2 meters.
3. Maximum depth: 1.8 meters.
4. Volume: 1.548×10^6 m^3.
5. Mean hydraulic retention time: 1.2 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Silver Lake Marsh Outlet	2.4	0.01
Minor tributaries & immediate drainage -	4.5	0.03
Totals	6.9	0.04

2. Outlet -

Goose Creek	8.2**	0.04

C. Precipitation***:

1. Year of sampling: 63.6 centimeters.
2. Mean annual: 78.3 centimeters.

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† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Silver Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at a single station on the lake (see map, page v). During each visit, a depth-integrated (near bottom to surface) sample was collected for phytoplankton identification and enumeration; and a similar sample was collected for chlorophyll *a* analysis. During the first visit, an 18.9-liter depth-integrated sample was collected for algal assays. The maximum depth sampled was 1.5 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not properly preserved and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SILVER LAKE
STORET CODE 1912

PARAMETER	1ST SAMPLING (4/18/74) 1 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 3/74) 1 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/23/74) 1 SITES RANGE	MEAN	MEDIAN
TEMP (C)	10.5 - 10.5	10.5	10.5	23.8 - 23.8	23.8	23.8	13.0 - 13.0	13.0	13.0
DISS OXY (MG/L)	10.0 - 10.0	10.0	10.0	5.0 - 6.0	5.5	5.5	8.4 - 10.2	9.3	9.3
CNDCTVY (MCROMO)	115. - 168.	142.	142.	273. - 282.	278.	278.	148. - 149.	149.	149.
PH (STAND UNITS)	8.5 - 8.5	8.5	8.5	8.9 - 9.0	8.9	8.9	9.3 - 9.6	9.5	9.5
TOT ALK (MG/L)	139. - 143.	141.	141.	****** -**********			78. - 81.	80.	80.
TOT P (MG/L)	0.080 - 0.482	0.281	0.281	****** -**********			0.187 - 0.200	0.193	0.193
ORTHO P (MG/L)	0.018 - 0.038	0.028	0.028	****** -**********			0.033 - 0.035	0.034	0.034
NO2+NO3 (MG/L)	0.720 - 0.820	0.770	0.770	****** -**********			0.040 - 0.040	0.040	0.040
AMMONIA (MG/L)	0.330 - 0.390	0.360	0.360	****** -**********			0.040 - 0.040	0.040	0.040
KJEL N (MG/L)	2.500 -11.800	7.150	7.150	****** -**********			4.100 - 4.600	4.350	4.350
INORG N (MG/L)	1.050 - 1.210	1.130	1.130	****** -**********			0.080 - 0.080	0.080	0.080
TOTAL N (MG/L)	3.220 -12.620	7.920	7.920	****** -**********			4.140 - 4.640	4.390	4.390
CHLRPYL A (UG/L)	20.5 - 20.5	20.5	20.5	174.7 - 174.7	174.7	174.7	90.7 - 90.7	90.7	90.7
SECCHI (METERS)	0.6 - 0.6	0.6	0.6	0.4 - 0.4	0.4	0.4	0.3 - 0.3	0.3	0.3

B. Biological characteristics:

1. Phytoplankton* -

Sampling Date	Dominant Genera	Algal Units per ml
07/03/74	1. Lyngbya sp.	47,518
	2. Aphanizomenon sp.	10,914
	3. Melosira sp.	5,022
	4. Synedra sp.	4,443
	5. Scenedesmus sp.	3,477
	Other genera	11,299
	Total	82,673
09/23/74	1. Lyngbya sp.	184,949
	2. Aphanizomenon sp.	10,192
	3. Microcystis sp.	8,281
	4. Scenedesmus sp.	2,549
	5. Aphanocapsa sp.	1,274
	Other genera	4,672
	Total	211,917

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/18/74	1	20.5
07/03/74	1	174.7
09/23/74	1	90.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.045	1.055	23.6
0.050 P	0.095	1.055	29.5
0.050 P + 1.0 N	0.095	2.055	39.0
1.0 N	0.045	2.055	25.4

* The April phytoplankton sample was lost in shipment.

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Silver Lake was very high at the time the sample was collected (04/18/74). Also, a significant increase in yield with the addition of phosphorus alone indicates that the lake was limited by phosphorus at that time. Note that the addition of nitrogen alone resulted in a yield which was not significantly greater than that of the control.

The lake data indicate phosphorus limitation in April and nitrogen limitation in September (the mean inorganic nitrogen to orthophosphorus ratios were 40 to 1 and 2 to 1, respectively).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Iowa National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v) in the autumn and bimonthly samples in the spring. Samples could not be collected from December through February because of ice cover. Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads, in $kg/km^2/year$, at station A-2 and multiplying by the ZZ area in km^2.

No known point sources impacted Silver Lake during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Silver Lake Marsh Outlet	100	31.7
b. Minor tributaries & immediate drainage (non-point load) -	190	60.3
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	25	8.0
Total	315	100.0

2. Outputs -

Lake outlet - Goose Creek 200

3. Net annual P accumulation - 115 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Silver Lake Marsh Outlet	1,250	25.0
b. Minor tributaries & immediate drainage (non-point load) -	2,345	47.0
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	1,395	28.0
Total	4,990	100.0

2. Outputs -

Lake outlet - Goose Creek 5,495

3. Net annual N loss 505 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Silver Lake Marsh Outlet	42	521

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.24	0.09	3.9	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Silver Lake:

"Dangerous" (eutrophic loading)	0.20
"Permissible" (oligotrophic loading)	0.10

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, or underestimation of the minor tributary and immediate drainage load. Whatever the cause, a similar nitrogen loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's former National Eutrophication and Lake Restoration Branch (Malueg et al., 1975).

V. LITERATURE REVIEWED

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

Malueg, Kenneth W., D. Phillips Larsen, Donald W. Schults, and Howard T. Mercier; 1975. A six-year water, phosphorus, and nitrogen budget for Shagawa Lake, Minnesota. Jour. Environ. Qual., vol. 4, no. 2, pp. 236-242.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACOUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	296
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IOWA 12/23/75

LAKE CODE 1912 SILVER LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 8.2

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1912A1	8.2	0.01	0.01	0.07	0.13	0.05	0.05	0.03	0.03	0.02	0.02	0.02	0.01	0.04
1912A2	2.4	0.00	0.00	0.02	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01
1912ZZ	5.7	0.01	0.01	0.05	0.09	0.04	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0.03

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 8.2
SUM OF SUB-DRAINAGE AREAS = 8.2

TOTAL FLOW IN = 0.45
TOTAL FLOW OUT = 0.45

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1912A1	8	74	0.01	17	0.00				
	9	74	0.00	8	0.00				
	10	74	0.00	5	0.00				
	11	74	0.00	3	0.00				
	12	74	0.00	18	0.00				
	1	75	0.00	4	0.00				
	2	75	0.01	2	0.01				
	3	75	0.04	20	0.01				
	4	75	0.23	7	0.14	21	0.25		
	5	75	0.16	4	0.28	19	0.09		
	6	75	0.16	10	0.10	23	0.22		
	7	75	0.09	7	0.16	21	0.04		
1912A2	8	74	0.00	17	0.0				
	9	74	0.00	8	0.00				
	10	74	0.00	5	0.00				
	11	74	0.00	3	0.00				
	12	74	0.00	18	0.00				
	1	75	0.00	4	0.00				
	2	75	0.00	2	0.00				
	3	75	0.01	20	0.00				
	4	75	0.07	7	0.04	21	0.07		
	5	75	0.05	4	0.09	19	0.03		
	6	75	0.05	10	0.03	23	0.07		
	7	75	0.03	7	0.05	21	0.01		
1912ZZ	8	74	0.00						
	9	74	0.00						
	10	74	0.00						
	11	74	0.00						
	12	74	0.00						
	1	75	0.00						
	2	75	0.01						
	3	75	0.03						
	4	75	0.16						
	5	75	0.11						
	6	75	0.13						
	7	75	0.07						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/02/02

191201
43 29 00.0 092 25 00.0
SILVER LAKE
19 IOWA

11EPALES
4

2111202
0007 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	10 20	0000	10.5		25	115	8.50	143	0.330	2.500	0.720	0.018
	10 20	0005	10.5	10.0		168	8.50	139	0.390	11.800	0.820	0.038
74/07/03	10 20	0000	23.8	6.0	15	273	9.00					
	10 20	0004	23.8	5.0		282	8.90					
74/09/23	13 30	0000	13.0	8.4	12	149	9.62	81	0.040	4.100	0.040	0.033
	13 30	0005	13.0	10.2		148	9.33	78	0.040	4.600	0.040	0.035

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	10 20	0000	0.080	20.5	
	10 20	0005	0.482		
74/07/03	10 20	0000		174.7	
	10 20	0001			50.0
	10 20	0003			1.0
74/09/23	13 30	0000	0.187	90.7	
	13 30	0001			50.0
	13 30	0003			1.0
	13 30	0005	0.200		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

1912A1
43 29 00.0 093 24 00.0
GOOSE CREEK
19 WORTH CO HWY MAP
0/SILVER LAKE
SEC RD S22 BRDG 1 MI W OF SILVER LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	08 55		1.260	2.400	0.770	0.020	0.170
74/09/08	14 20		0.704	3.000	1.050	0.020	0.175
74/10/05	14 45		0.680	2.700	0.880	0.025	0.155
74/11/03	12 40		0.850	2.100	0.580	0.052	0.090
75/03/20	15 00		3.300	2.100	0.860	0.065	0.140
75/04/07	14 43		2.700	2.800	0.600	0.030	0.120
75/04/21	13 30		2.200	2.100	0.340	0.020	0.150
75/05/04	09 00		1.650	2.550	0.125	0.035	0.095
75/05/19	10 10		0.500	3.300	0.115	0.025	0.210
75/06/10	10 30		0.440	5.250	1.600	0.020	0.180
75/06/23	10 30		0.460	5.250	1.500	0.100	0.280
75/07/07	13 10		0.525	4.800	2.100	0.110	0.200
75/07/21	13 00		0.970	3.750	0.580	0.065	0.230

STORET RETRIEVAL DATE 76/01/27

1912A2
43 29 20.0 093 26 10.0
SILVER LK MARSH OUTLET
19 WORTH CO HWY MAP
T/SILVER LAKE
AT SILVER LAKE MARSH OUTLET CNTRL STRUCT
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	09	10	0.028	2.500	0.080	0.110	0.400
74/09/08	14	35	0.016	2.400	0.065	0.045	0.240
74/10/05	15	00	0.128	4.200	0.020	0.080	0.370
74/11/03	12	50	0.016	3.300	0.090	0.110	0.460
75/04/07	14	50	3.900	2.800	1.050	0.055	0.240
75/04/21	13	40	5.600	1.530	0.113	0.040	0.115
75/05/04	09	10	4.900	1.800	0.630	0.027	0.040
75/05/19	10	25	0.025	2.250	0.110	0.200	0.360
75/06/10	10	45	0.005	1.150	0.032	0.120	0.190
75/06/23	10	45	0.005	0.950	0.035	0.105	0.160
75/07/07	13	20	0.015	2.100	0.060	0.260	0.460
75/07/21	13	15	0.015	1.850	0.080	0.180	0.480